National Aeronautics and Space Administration

Next Generation High Power Multi-Frequency Transmitter For Space Borne Doppler Radar Sensing and Precipitation Measurements

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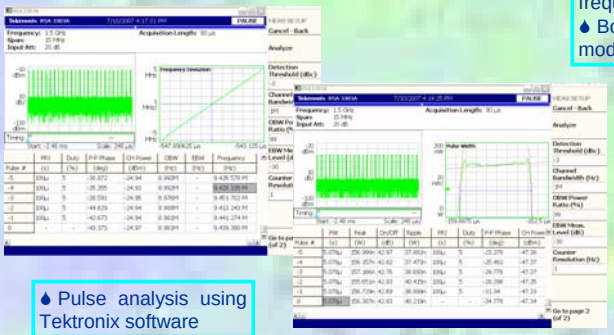
Background

Tropical Rainfall Measuring Mission

- The only current U.S. satellite based precipitation measurement radar, launched in 1997, operates at a single Ku-band frequency of 13.8GHz and is on the NASA's Tropical Rainfall Measuring Mission (TRMM) satellite. It computes intensity, variability and the spatial distribution of rainfall, rain type, storm depth, and other essential weather data[1].

Our Approach

- Testing feasibility of operating a single Ka-band TWT to amplify two pulses



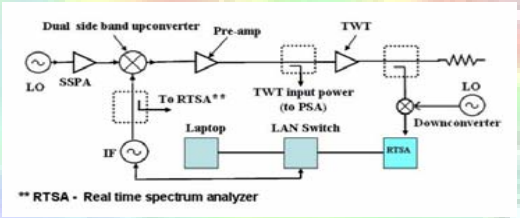
- Pulse analysis using Tektronix software

Global Precipitation Mission

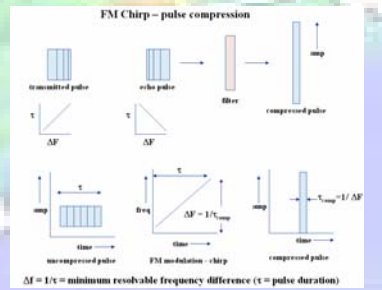
- The TRMM is limited in its capability of measuring accurate rainfall estimations. The Global Precipitation Mission (GPM) has been proposed, which would allow for more detailed observations of rainfall processes and significantly more accurate rainfall measurements[1].

- It would produce superior estimates of drop size and distribution since it would be a dual-frequency radar system operated at both Ku-band (13.8GHz) and Ka-band (35.6GHz). The GPM would require two TWTs with possibly two antennas[1].

Circuit Diagram



- FM modulated pulse (IF) at 1.75GHz mixes with LO signal in upconverter
- Mathematical result is LO±IF
- Signals sent through TWT
- Downconverter mixes two RF frequencies with a second LO frequency to obtain two IF frequencies that are within range of RTSA
- Both IF bands are looked at separately using RTSA to compare modulated pulses



Differential Frequency Precipitation Radar

- Calculations have been performed by Dr. R. Meneghini at NASA GSFC that present the possibility of an approach using only a single transmitter and smaller antenna. The same increased accuracy in precipitation measurements as GPM would result when a pulsed radar system with two Ka-band frequencies spaced 7-10% apart were used, thus reducing the size, mass and electrical power required for the system[1].
- It would have the capability of measuring rain drop size distribution with minimum diameters of 0.1mm, vertical air motion, and storm dynamics from the measured differential reflectivity and Doppler shift[1].

- Signal sources

- Performing data analysis using a Tektronix RSA 3303A Real-Time Spectrum Analyzer

- Our Setup

Future Work

- Refine ability to evaluate radar pulse modulations (FM chirp)
- Compare our findings to GSFC calculations
- Discover way to quantitatively test accuracy of pulse results after passing through TWT

Reference

[1] Wintucky, Edwin G., and Rainee N. Simons. Next Generation High Power Multi-Frequency Transmitter for Space Borne Doppler Radar Sensing and Precipitation Measurements. NASA Glenn Research Center. 2007. 1-4.

Acknowledgements

Edwin Wintucky
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